THE ASTROPHYSICAL JOURNAL

CONTENTS OF VOLUME 509, PART 1

1998 DECEMBER 10, Number 1

Page

THE DEUTERIUM CHEMISTRY OF THE EARLY UNIVERSE 1
P. C. Stancil, S. Lepp, & A. Dalgarno

COSMOLOGICAL NEUTRINO BACKGROUND REVISITED 11
Nickolay Y. Gnedin & Oleg Y. Gnedin

TESTING COLD DARK MATTER MODELS AT MODERATE TO HIGH REDSHIFT 16
Renyue Cen

TOWARD LOCATING THE BRIGHTEST MICROLENSING EVENTS ON THE SKY 39
Robert J. Nemiroff

GRAVITATIONAL MAGNIFICATION OF POPULATION III SUPERNOVAE IN HIERARCHICAL COSMOLOGICAL MODELS: NEXT GENERATION SPACE TELESCOPE PERSPECTIVES 43
Simone Marri & Andrea Ferrara

THE X-RAY FOREST: A NEW PREDICTION OF HIERARCHICAL STRUCTURE FORMATION MODELS 56
Uffe Hellsten, Nickolay Y. Gnedin, & Jordi Miralda-Escudé

NONEQUILIBRIUM THERMODYNAMICS AND COSMOLOGICAL PANCAKE FORMATION 62
Romain Teyssier, Jean-Pierre Chièze, & Jean-Michel Alimi

SUPERNOVA LIMITS ON THE COSMIC EQUATION OF STATE 74
Peter M. Garnavich, Saurabh Jha, Peter Challis, Alejandro Clocchiatti, Alan Diercks, Alexei V. Filippenko, Ron L. Gilliland, Craig J. Hogan, Robert P. Kirshner, Bruno Leibundgut, M. M. Phillips, David Reiss, Adam G. Riess, Brian P. Schmidt, Robert A. Schommer, R. Chris Smith, Jason Spyromilio, Chris Stubbs, Nicholas B. Suntzeff, John Tonry, & Sean M. Carroll

THE PEAK BRIGHTNESS OF SN 1974G IN NGC 4414, AND THE HUBBLE CONSTANT 80
Bradley E. Schaefer

DOES THE THERMAL DISK INSTABILITY OPERATE IN ACTIVE GALACTIC NUCLEI? 85
L. Burderi, A. R. King, & E. Szuszkiewicz

TOWARD A UNIFIED MODEL FOR THE "DIFFUSE IONIZED MEDIUM" IN NORMAL AND STARBURST GALAXIES 93
Jing Wang, Timothy M. Heckman, & Matthew D. Lehnert

MODELING THE EFFECTS OF DUST ON GALACTIC SPECTRAL ENERGY DISTRIBUTIONS FROM THE ULTRAVIOLET TO THE MILLIMETER BAND 103
Laura Silva, Gian Luigi Granato, Alessandro Bressan, & Luigi Danese

A SEARCH FOR ULTRARAPID MICROVARIABILITY IN THE SEYFERT GALAXY NGC 7469 WITH THE *HUBBLE SPACE TELESCOPE* 118
W. F. Welsh, B. M. Peterson, A. P. Koratkar, & K. T. Korista

THE VERY HIGHLY IONIZED BROAD ABSORPTION LINE SYSTEM OF THE QSO SBS 1542+541 132
Randal C. Telfer, Gerard A. Kriss, Wei Zheng, Arthur F. Davidsen, & Richard F. Green

THE X-RAY SPECTRAL VARIABILITY OF THE SEYFERT GALAXY NGC 3227 146
I. M. George, R. Mushotzky, T. J. Turner, T. Yaqoob, A. Ptak, K. Nandra, & H. Netzer

STEPS TOWARD DETERMINATION OF THE SIZE AND STRUCTURE OF THE BROAD-LINE REGION IN ACTIVE GALACTIC NUCLEI. XIII. ULTRAVIOLET OBSERVATIONS OF THE BROAD-LINE RADIO GALAXY 3C 390.3 163
P. T. O'Brien, M. Dietrich, K. Leighly, D. Alloin, J. Clavel, D. M. Crenshaw, K. Horne, G. A. Kriss, J. H. Krolik, M. A. Malkan, H. Netzer, B. M. Peterson, G. A. Reichert, P. M. Rodríguez-Pascual, W. Wamsteker, K. S. J. Anderson, N. G. Bochkarev, F.-Z. Cheng, A. V. Filippenko, C. M. Gaskell, I. M. George, M. R. Goad, L. C. Ho, S. Kaspi, W. Kollatschny, K. T. Korista, G. MacAlpine, D. Marlow, P. G. Martin, S. L. Morris, R. W. Pogge, B.-C. Qian, M. C. Recondo-Gonzalez, J. M. Rodríguez Espinosa, M. Santos-Lleó, A. I. Shapovalova, J. M. Shull, G. M. Stirpe, W.-H. Sun, T. J. Turner, R. Vio, S. Wagner, I. Wanders, K. A. Wills, H. Wu, S.-J. Xue, & Z.-L. Zou

ON MICROLENSING EVENT RATES AND OPTICAL DEPTH TOWARD THE GALACTIC CENTER 177
S. J. Peale

CONTENTS

Page

LUMINOSITY FUNCTIONS FOR GLOBULAR CLUSTERS 192
Fabio Silvestri, Paolo Ventura, Francesca D'Antona, & Italo Mazzitelli

EVIDENCE FOR THE GALACTIC X-RAY BULGE. II. 203
Sangwook Park, John P. Finley, & T. M. Dame

PROPAGATION OF COSMIC-RAY NUCLEONS IN THE GALAXY 212
Andrew W. Strong & Igor V. Moskalenko

CONSTRAINTS ON THE FORMATION AND EVOLUTION OF CIRCUMSTELLAR DISKS IN ROTATING MAGNETIZED CLOUD CORES 229
Shantanu Basu

CHARGED-PARTICLE MOTION IN ELECTROMAGNETIC FIELDS HAVING AT LEAST ONE IGNORABLE SPATIAL COORDINATE 238
Frank C. Jones, J. Randy Jokipii, & Matthew G. Baring

A DIVERGENCE-FREE UPWIND CODE FOR MULTIDIMENSIONAL MAGNETOHYDRODYNAMIC FLOWS 244
Dongsu Ryu, Francesco Miniati, T. W. Jones, & Adam Frank

A WATER MASER FLARE IN W49N: AMPLIFICATION BY A ROTATING FOREGROUND CLOUD 256
D. A. Boboltz, John H. Simonetti, Brian Dennison, P. J. Diamond, & J. A. Uphoff

SYSTEMS WITH H_2O MASER AND 1.3 CENTIMETER CONTINUUM EMISSION IN CEPHEUS A 262
José M. Torrelles, José F. Gómez, Guido Garay, Luis F. Rodríguez, Salvador Curiel, R. Jim Cohen, & Paul T. P. Ho

EXPANSION OF W3(OH) 270
Jonathan H. Kawamura & Colin R. Masson

MID-INFRARED IMAGING OF ORION BN/KL. II. LUMINOSITY SOURCES, EXTINCTION DISTRIBUTION, AND THE NATURE OF IRc2 283
D. Y. Gezari, D. E. Backman, & M. W. Werner

350 MICRON CONTINUUM IMAGING OF THE ORION A MOLECULAR CLOUD WITH THE SUBMILLIMETER HIGH ANGULAR RESOLUTION CAMERA 299
D. C. Lis, E. Serabyn, Jocelyn Keene, C. D. Dowell, D. J. Benford, T. G. Phillips, T. R. Hunter, & N. Wang

A SEARCH FOR PECULIAR OBJECTS WITH THE NASA ORBITAL DEBRIS OBSERVATORY 3 METER LIQUID MIRROR TELESCOPE 309
Rémi A. Cabanac, Ermanno F. Borra, & Mario Beauchemin

HIGH-RESOLUTION FAR-INFRARED STUDIES OF INTERMEDIATE-MASS PRE–MAIN-SEQUENCE OBJECTS 324
James Di Francesco, Neal J. Evans II, Paul M. Harvey, Lee G. Mundy, & Harold M. Butner

DETAILED MID- AND FAR-ULTRAVIOLET MODEL SPECTRA FOR ACCRETION DISKS IN CATACLYSMIC BINARIES 350
Richard A. Wade & Ivan Hubeny

THE UNUSUAL EVOLUTIONARY STATE OF GRO J1655−40 362
Enikö Regös, Christopher A. Tout, & Dayal Wickramasinghe

ABUNDANCE ANALYSES OF FIELD RV TAURI STARS. IV. AD AQUILAE, DS AQUARII, V360 CYGNI, AC HERCULIS, AND V453 OPHIUCHI 366
Sunetra Giridhar, David L. Lambert, & Guillermo Gonzalez

NEW LIGHT SYNTHESIS AND SPECTRUM SYNTHESIS CONSTRAINTS ON A MODEL FOR B LYRAE 379
A. P. Linnell, I. Hubeny, & P. Harmanec

MASS-LOSS HISTORIES OF THREE CARBON-RICH EVOLVED STARS AS REVEALED BY ^{12}CO EMISSION 392
M. Meixner, M. T. Campbell, W. J. Welch, & L. Likkel

ENERGETIC PARTICLE EVENTS: EFFICIENCY OF INTERPLANETARY SHOCKS AS 50 keV $< E <$ 100 MeV PROTON ACCELERATORS 415
D. Lario, B. Sanahuja, & A. M. Heras

DYNAMICS OF MAGNETIC FLUX ELEMENTS IN THE SOLAR PHOTOSPHERE 435
A. A. van Ballegooijen, P. Nisenson, R. W. Noyes, M. G. Löfdahl, R. F. Stein, Å. Nordlund, & V. Krishnakumar

THE WAITING-TIME DISTRIBUTION OF SOLAR FLARE HARD X-RAY BURSTS 448
M. S. Wheatland, P. A. Sturrock, & J. M. McTiernan

SOLAR CYCLE ONSET SEEN IN *SOHO* MICHELSON DOPPLER IMAGER SEISMIC DATA 456
W. A. Dziembowski, P. R. Goode, M. P. DiMauro, A. G. Kosovichev, & J. Schou

CONTENTS

Page

COMPARISON OF Hα AND He II λ304 MACROSPICULES 461
Haimin Wang

CONSTRAINTS ON NONLINEAR AND STOCHASTIC GROWTH THEORIES FOR TYPE III SOLAR RADIO BURSTS FROM THE CORONA TO 1 AU 471
Iver H. Cairns & P. A. Robinson

1998 DECEMBER 20, Number 2

SMALL-SCALE ANISOTROPY OF THE COSMIC BACKGROUND RADIATION AND SCATTERING BY CLOUDY PLASMA 483
P. J. E. Peebles & R. Juszkiewicz

GAUSSIAN PEAKS AND CLUSTERS OF GALAXIES 494
Renyue Cen

SELF-SIMILAR EVOLUTION OF GRAVITATIONAL CLUSTERING. II. N-BODY SIMULATIONS OF THE $n = -2$ SPECTRUM 517
Bhuvnesh Jain & Edmund Bertschinger

LARGE-SCALE FLUCTUATIONS IN THE X-RAY BACKGROUND 531
Marie Treyer, Caleb Scharf, Ofer Lahav, Keith Jahoda, Elihu Boldt, & Tsvi Piran

GAMMA-RAY BURSTS FROM BARYON DECAY IN NEUTRON STARS 537
Ue-Li Pen, Abraham Loeb, & Neil Turok

GAS DENSITY AND X-RAY SURFACE BRIGHTNESS PROFILES OF CLUSTERS OF GALAXIES FROM DARK MATTER HALO POTENTIALS: BEYOND THE ISOTHERMAL β-MODEL 544
Yasushi Suto, Shin Sasaki, & Nobuyoshi Makino

AN INFRARED EINSTEIN RING IN THE GRAVITATIONAL LENS PG 1115+080 551
C. D. Impey, E. E. Falco, C. S. Kochanek, J. Lehár, B. A. McLeod, H.-W. Rix, C. Y. Peng, & C. R. Keeton

THE OPTICAL PROPERTIES OF GRAVITATIONAL LENS GALAXIES AS A PROBE OF GALAXY STRUCTURE AND EVOLUTION 561
C. R. Keeton, C. S. Kochanek, & E. E. Falco

A TWO-TEMPERATURE MODEL OF THE INTRACLUSTER MEDIUM 579
Motokazu Takizawa

QUANTITATIVE ESTIMATES OF ENVIRONMENTAL EFFECTS ON THE STAR FORMATION RATE OF DISK GALAXIES IN CLUSTERS OF GALAXIES 587
Yutaka Fujita

THE PISCES-PERSEUS SUPERCLUSTER AND GRAVITATIONAL QUASI-EQUILIBRIUM CLUSTERING 595
William C. Saslaw & Shirin Haque-Copilah

CONSTRAINTS ON THE PHYSICAL PARAMETERS OF TeV BLAZARS 608
Fabrizio Tavecchio, Laura Maraschi, & Gabriele Ghisellini

NITROGEN ABUNDANCES IN DAMPED Lyα GALAXIES 620
Miriam Centurión, Piercarlo Bonifacio, Paolo Molaro, & Giovanni Vladilo

OPTICAL CLASSIFICATION OF MEGAMASER GALAXIES 633
Willem A. Baan, John J. Salzer, & Robin D. LeWinter

HUBBLE SPACE TELESCOPE WFPC2 IMAGING OF THE SEYFERT GALAXY NGC 3516 646
Pierre Ferruit, Andrew S. Wilson, & John S. Mulchaey

NEAR-INFRARED AND X-RAY OBSCURATION TO THE NUCLEUS OF THE SEYFERT 2 GALAXY NGC 3281 653
Chris Simpson

CONSTRAINING THE METALLICITY OF THE LOW-DENSITY Lyα FOREST USING O VI ABSORPTION 661
Romeel Davé, Uffe Hellsten, Lars Hernquist, Neal Katz, & David H. Weinberg

HIGH PROPER-MOTION STARS IN THE VICINITY OF SAGITTARIUS A*: EVIDENCE FOR A SUPERMASSIVE BLACK HOLE AT THE CENTER OF OUR GALAXY 678
A. M. Ghez, B. L. Klein, M. Morris, & E. E. Becklin

THE 1995 PILOT CAMPAIGN OF PLANET: SEARCHING FOR MICROLENSING ANOMALIES THROUGH PRECISE, RAPID, ROUND-THE-CLOCK MONITORING 687
M. Albrow, J.-P. Beaulieu, P. Birch, J. A. R. Caldwell, S. Kane, R. Martin, J. Menzies, R. M. Naber, J.-W. Pel, K. Pollard, P. D. Sackett, K. C. Sahu, P. Vreeswijk, A. Williams, & M. A. Zwaan (The PLANET Collaboration)

Page

MAGNETOHYDRODYNAMIC MODELING OF A GALACTIC SPIRAL ARM AS A COMBINATION SHOCK AND HYDRAULIC JUMP 703
Marco A. Martos & Donald P. Cox

FLUID DYNAMICS OF SEMIRADIATIVE BLAST WAVES 717
Ehud Cohen, Tsvi Piran, & Re'em Sari

THE ONSET OF MOLECULAR HYDROGEN EMISSION FROM PROTO–PLANETARY NEBULAE 728
David A. Weintraub, Tracy Huard, Joel H. Kastner, & Ian Gatley

PROTOSTARS IN PERSEUS: OUTFLOW-INDUCED FRAGMENTATION 733
Mary Barsony, Derek Ward-Thompson, Philippe André, & JoAnn O'Linger

A NEAR-INFRARED STUDY OF THE NS 14 BIPOLAR NEBULA 749
Eric M. Howard, Judith L. Pipher, & William J. Forrest

ASCA OBSERVATIONS OF THE T TAURI STAR SU AURIGAE AND THE SURROUNDING L1517 DARK CLOUD 761
Stephen L. Skinner & Frederick M. Walter

MOLECULAR ABUNDANCE ENHANCEMENTS IN THE HIGHLY COLLIMATED BIPOLAR OUTFLOW BHR 71 768
Guido Garay, Ive Köhnenkamp, Tyler L. Bourke, L. F. Rodríguez, & Kimmo K. Lehtinen

THE SECOND CAMBRIDGE PULSAR SURVEY AT 81.5 MHz 785
J. A. Shrauner, J. H. Taylor, & G. Woan

EFFECTS OF RAPID STELLAR ROTATION ON EQUATION-OF-STATE CONSTRAINTS DERIVED FROM QUASI-PERIODIC BRIGHTNESS OSCILLATIONS 793
M. Coleman Miller, Frederick K. Lamb, & Gregory B. Cook

THE STRUCTURE AND EMISSION OF THE ACCRETION SHOCK IN T TAURI STARS 802
Nuria Calvet & Erik Gullbring

THE RESPONSE OF ACCRETION DISKS TO BENDING WAVES: ANGULAR MOMENTUM TRANSPORT AND RESONANCES 819
Caroline E. J. M. L. J. Terquem

INFRARED COLORS AT THE STELLAR/SUBSTELLAR BOUNDARY 836
S. K. Leggett, F. Allard, & P. H. Hauschildt

HYDROGEN-LIKE ION EMISSION IN THE SPECTRA OF LOW-MASS X-RAY BINARIES 848
M. A. Bautista, T. R. Kallman, L. Angelini, D. A. Liedahl, & D. P. Smits

DETERMINATION OF THE GEOMETRY OF THE PSR B1913+16 SYSTEM BY GEODETIC PRECESSION 856
Michael Kramer

RADIO EMISSION AND PARTICLE ACCELERATION IN SN 1993J 861
Claes Fransson & Claes-Ingvar Björnsson

AN EMPIRICAL ISOCHRONE OF VERY MASSIVE STARS IN R136a 879
Alex de Koter, Sara R. Heap, & Ivan Hubeny

THE TWO-COMPONENT X-RAY BROADBAND SPECTRUM OF X PERSEI OBSERVED BY *BeppoSAX* 897
T. Di Salvo, L. Burderi, N. R. Robba, & M. Guainazzi

THE FIRST ULTRAVIOLET AND OPTICAL SPECTROPOLARIMETRY OF THE B[e] STAR HD 50138 904
K. S. Bjorkman, A. S. Miroshnichenko, J. E. Bjorkman, M. R. Meade, B. L. Babler, A. D. Code, C. M. Anderson, G. K. Fox, J. J. Johnson, A. J. Weitenbeck, N. E. B. Zellner, & O. L. Lupie

THE ELECTRON INJECTION FUNCTION AND ENERGY-DEPENDENT DELAYS IN THICK-TARGET HARD X-RAYS 911
John C. Brown, Andrew J. Conway, & Markus J. Aschwanden

SPATIOTEMPORAL CORRELATIONS AND TURBULENT PHOTOSPHERIC FLOWS FROM *SOHO*/MDI VELOCITY DATA 918
A. C. Cadavid, J. K. Lawrence, A. A. Ruzmaikin, S. R. Walton, & T. Tarbell

Fe^+ IN ITS GROUND ^6D STATE: A DIRECT MEASUREMENT OF THE $J = 1/2–3/2$ AND $J = 3/2–5/2$ FINE-STRUCTURE INTERVALS 927
John M. Brown, Helga Körsgen, & Kenneth M. Evenson

Page

ERRATA

[O I] 63 Micron Absorption in NGC 6334 931
Kathleen E. Kraemer, James M. Jackson, & Adair P. Lane

The Sensitivity of Gas-Phase Chemical Models of Interstellar Clouds to C and O Elemental Abundances and to a New Formation Mechanism for Ammonia 932
R. Terzieva & Eric Herbst

Dynamical Evolution of Elliptical Galaxies with Central Singularities 933
David Merritt & Gerald D. Quinlan

ABSTRACTS OF THE ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES, 1999 JANUARY

Analytical Fit to the Luminosity Distance for Flat Cosmologies with a Cosmological Constant 934
Ue-Li Pen

A VLA Search for Head-Tail Radio Sources in Abell Clusters 934
Kevin B. Marvel, Hemant Shukla, & George Rhee

The Population of Weak Mg II Absorbers. I. A Survey of 26 QSO HIRES/Keck Spectra 934
Christopher W. Churchill, Jane R. Rigby, Jane C. Charlton, & Steven S. Vogt

Total Flux Density Variations in Extragalactic Radio Sources. I. Decomposition of Variations into Exponential Flares 935
E. Valtaoja, A. Lähteenmäki, H. Teräsranta, & M. Lainela

A 14 Year Program Monitoring the Flux Densities of 33 Radio Sources at Low Frequencies 935
José Francisco Salgado, Daniel R. Altschuler, Tapasi Ghosh, Brian K. Dennison, Kenneth J. Mitchell, & Harry E. Payne

Dense Molecular Clouds in the Galactic Center Region. I. Observations and the Data 935
Masato Tsuboi, Toshihiro Handa, & Nobuharu Ukita

Faint Emission Lines and Temperature Fluctuations in M8 936
César Esteban, Manuel Peimbert, Silvia Torres-Peimbert, Jorge García-Rojas, & Mónica Rodríguez

Classical Cepheids Pulsation Models. I. Physical Structure 936
Giuseppe Bono, Marcella Marconi, & Robert F. Stellingwerf

Orbits of Five Visual Double Stars 937
J. A. Docobo & J. F. Ling

Numerical Simulations of Fe II Emission Spectra 937
E. M. Verner, D. A. Verner, K. T. Korista, J. W. Ferguson, F. Hamann, & G. J. Ferland

Electron-Ion Recombination Rate Coefficients, Photoionization Cross Sections, and Ionization Fractions for Astrophysically Abundant Elements. II. Oxygen Ions 937
Sultana N. Nahar